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West Comes East: The Emerging Global Acidic Crude Market

By

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Executive Summary

- In such times of market uncertainty we set out our assumptions on crude prices, current and future. We believe that: prices in a steady range of \$90/BBL plus are unsustainable, though short-lived spikes of \$100/BBL plus are likely and possibly will occur on more than one occasion; that a medium-term average range, through 2010, of \$65-70/BBL for Brent is likely, with increased price volatility in the short term; that a substantial crude production capacity buffer will only emerge in the coming decade and that Asia Pacific will remain structurally dependent on ever increasing volumes of crude imports, mainly from the Mideast Gulf. We discount the possibility of *peak oil* production in the period of this study, through 2015. While the role of hedge funds and the currently weak US dollar remain unclear, both factors certainly support a sustained period of high crude prices.
- The further rise in crude prices over the course of the second half of 2007 to \$90/BBL plus levels has finally begun to destroy demand growth in OECD markets. The first signs of demand slowing in Asia Pacific, both in advanced economies and Developing Asia markets, had appeared by the second half of 2007. While OECD markets have seen an absolute decline in oil demand, particularly in transport fuels, Asia Pacific has experienced a slowing of demand growth, though overall consumption has continued to rise at a moderate pace. We believe that world markets, even in vibrant Asia Pacific, have entered a demand *killing zone*, with a moderating impact on crude prices.
- Slowing demand growth, together with an enormous volume of new refining capacity, due to start up by 2010, will shift Asia Pacific from a region where oil prices had been led by products availability, to that of markets, as in the Atlantic Basin, led by crude availability and price. The Mideast Gulf, mainly Organization of Petroleum Exporting Countries (OPEC) producers, will continue to provide most extra-regional crude supply to Asia Pacific. Yet a substantial minority share of imports will continue to be low-sulfur, mid-weight to heavy. These crudes will be necessary to meet Asia Pacific's tightening product specifications, the region's high proportion of gas oil, in particular diesel, consumption, to fill incremental crude needs in face of stagnant Asia-Pacific crude output and to fill slates for less sophisticated Asian refineries.
- Asia Pacific's need for low-sulfur crude that produces a high volume of gas oil and/or residual fuel will be one *Pull* factor attracting high-TAN output from West of Suez. The discount on high-TAN crudes will also be a *Pull* factor for Asian buyers, particularly as refiners look for less expensive sweet grades. *Push* factors that will likely increase arbitrage sales east to Asian refiners, include a disproportionate buildup of high-TAN output in West Africa, Sudan and Latin America, a lack of refining, particularly refining suited to handling high-TAN crudes in this area; and political supports, including Venezuela's drive to increase sales to China and Asia Pacific in general. Incremental high-TAN crude output should rise by 1.8MM B/D in the period 2005-2010, with 61% of that gain expected in West of Suez production regions. High-TAN production, trade and use will increase globally – but we believe

Asia Pacific will be the focus of inter-regional acidic crude trade through the next decade.

- Acidic crude can be defined in a number of ways. High-TAN or acidic crudes are grades that contain substantial naphthenic acid volume. Acidity is measured by the amount of potassium hydroxide (KOH) needed to neutralize acidity. We have used a break point of 1.0 mg KOH/g, with crude containing more than 1.0 mg KOH/g considered high-TAN grades. Acidic crudes are only united by their high-TAN content and can vary extensively in most other physical characteristics. It is true though that most high-TAN crudes are mid-weight to heavy, (all under 29 API), usually are low in sulfur content (with the notable exception of Venezuelan grades) and often produce a disproportionate gas oil yield when refined. While high-TAN crude output occurs in every oil-producing region of the world, this study focuses on internationally traded acidic grades and their impact on Asia-Pacific markets.
- China has been the big gainer in high-TAN crude production in recent years and will continue to dominate output through 2015 and substantial jumps in production by foreign equity fields QHD and Penglai are expected by 2010. Yet Australia, which produced minimal acidic crude output in the Wandoo field, will add substantial high-TAN output with the start-up of Vincent and Crosby, both moderately high-TAN grades that will be exported. Indonesia's Duri will increasingly be diverted to domestic use, but remains the closest thing to a regional high-TAN crude marker.
- West Africa added a number of new high-TAN grades since 2004 and while only a handful of additional acidic crudes will be commissioned through 2010, overall high-TAN output will continue to grow. In 2006, Angola, Chad and Sudan (which for purposes of crude group classification we have included in the West of Suez region) were the big guns for high-TAN production. Sudan will expand substantially further its acidic crude output, particularly for the very acidic Fula grade. A lack of refining capacity in most of these African market countries will spur export of high-TAN output.
- While North Sea overall production will decline, the UK and Norway will see marginal gains in high-TAN output. Most acidic crude production will continue to be used in NW Europe though the US market receives regular imports of Norwegian cargoes. Only some small-volume new high-TAN grades may emerge in this region by 2012.
- Latin America's high-TAN output will have an increasing impact on Asia Pacific by end-decade, with Venezuela pushing sales to China and Brazil, buying its first refinery in the region, with the Japanese complex also expected to serve as a break-bulk center for increased crude exports. While PDVSA's impetus for increased exports is political and Petrobras' commercial, the net result will be the same – a sharp increase in inter-regional sales of mainly acidic crude grades. While Venezuela will be struggling to maintain crude output through 2010, Brazil will be steadily adding new crude grades to its production list and steadily increasing overall oil

output.

- Iran's Norwuz will likely remain the only high-TAN crude grade produced in the Mideast Gulf. We expect that Central Asian and US high-TAN crude output will remain within the respective country/markets and will not be exported. If exported, acidic crude output will be blended off into moderate-TAN crude streams to allow pipeline exports. Canada will be able to export in large volume to Asia Pacific only when crude-carrying pipeline capacity is completed, not earlier than 2012-2013, and it is uncertain whether high-TAN crude will make up any significant part of Pacific sales.
- In countries producing and exporting high-TAN grades, acidic crude's share of overall oil production will rise from less than a fifth of all output in 2006 to a quarter of all production by 2010. When compared against total regional crude production in Asia Pacific, Africa, Europe, Latin America and the Mideast Gulf, acidic crude will rise from an 8% share of overall oil output in 2006 to 10.7% in 2010. West of Suez producers will add more total volume of high-TAN crude through 2015 and consistently will produce a larger percentage of world-traded high-TAN crude than East of Suez producers.
- Our analysis of commonly traded high-TAN grades took into account: overall crude quality, gas oil quality and quantity, total volume output, crude avails for export; distance from Asia Pacific and maximum cargo size as determining factors for what grades would be most suitable for supply to a theoretical buyer based in Singapore. The maximum *points* that could be gained was 30; Among the top 10 grades rated, all recording more than 21 points, were Penglai and QHD, Vincent and Crosby, as well as Duri, within Asia Pacific; Dar and Dalia were tipped from Africa; Heidrun from the North Sea and Marlim from Latin America. Other notable grades included Clair (UK) as well as Polvo, Albacora Leste and Roncador/P-54, all recently commissioned Brazilian crude streams. We believe that our priority crudes will be among the most likely to be sold as arbitrage grades regularly to Asia Pacific as well as exported within Asia Pacific.
- Acidic crude can be valued as a simple slate component (i.e. mainly on its gas oil yield), as cat-cracker feedstock, as fuel oil blendstock, as direct-burn crude, as base material for asphalt manufacture and as *opportunity crude*. These categories are not mutually exclusive, though one value tends to predominate.
- Traditional pricing for high-TAN crudes within Asia Pacific was based mainly on Duri; for Atlantic Basin arbitrage into Asia Pacific, the calculation was whether the premiums for a sweet crude with a high gas oil or fuel oil yield would be greater than the cost of transportation, less a discount for TAN. By early this decade, both systems showed signs of fragmentation.
- Currently high-TAN crude prices are based on a number of markers and a range of value systems. West of Suez crudes, including Sudanese exports, are usually marked

off of Brent; most Asia-Pacific crude still tends to use Duri as the basis point. Yet a number of Asia-Pacific crudes are valued more for their specialty utilization than a relationship to Duri, mainly in fuel oil blending, for lubes and asphalt manufacture. Some western high-TAN crudes, while maintaining a price relationship to Brent, such as Chad's Doba, are in reality much more impacted by low-sulfur fuel oil prices in NW Europe and low-sulfur waxy residual (LSWR). Venezuelan exports to Asia remain somewhat opaque, but are believed to depend on a number of factors besides Brent linkage and for asphalt-production grades, such as Boscan, may well have no relationship to any crude marker. Besides direct fuel oil blending, some high-TAN crude is used as boiler feed and as these are utilizations that do not involve refinery processing, they depend on other sets of values, notably the value of acidic crude in improving viscosity and sulfur levels for residual and the comparative cost of natural gas in power generation.

- Producers of high-TAN crude with extensive downstream systems have a pricing advantage over acidic crude producers without their own in-house downstream outlet. The emergence of any major new high-TAN grade tends to discount all acidic crudes. This is most noticeable when a high-TAN crude begins export from a producing country with little alternative but to sell output abroad.
- Price (as well as domestic demand pressures) will also be a primary driver in Brazilian efforts to increase sales into Asia Pacific. Brazil's sharp oil output rise in recent years has been mainly in mid-weight to heavy sweet grades, a good percentage of which has been in high-TAN grades. Domestic slates need more light sweet crude; Petrobras has been trading out heavy sweet grades, often acidic, to Asia Pacific, gaining a premium for the sweet nature of these exports, while balancing its domestic refining ends by importing more light crude from the Atlantic Basin.
- Product quality will be an ever more important support for the import of high-TAN crudes East of Suez. While reducing sulfur will be a primary refining goal for gasoline and residual, the key pressure remains to reduce and then virtually eliminate sulfur in gas oil, in particular road diesel. By 2010-2011, most major Asia-Pacific markets will have sulfur ceilings approaching 50 PPM for road diesel and refiners will be hard-pressed to meet this standard without running at least some sweet crude. Many grades of acidic crude give a large-volume yield of low-sulfur gas oil. Yet most grades produce gas oil with relatively low cetane value, implying that diesel derived from high-TAN crudes would have to be blended. Yet acidic crudes also have blending value in residual, both for viscosity (when combined with LSWR) and for their low sulfur content, when blended with high-sulfur residual.
- Half-a-dozen different groups can be identified as potential high-TAN crude buyers. These include: refineries with specialized metallurgy; large refineries that can dilute acidic crude and use as trim; those who buy high-TAN crude when discounted with sufficient specialized facilities to handle these grade; specialized, non-processing utilizations; risk-adverse refiners who will only occasionally experiment with high-TAN grades and finally, large and sophisticated refineries buying discounted acidic

crude in the hope of a double-dip in profits, using residual from high-TAN grades as cat-cracker feedstock. Refiners can handle acidic crudes safely through three main methods – dilution (i.e. blending with non-acidic crude); chemical injection, to neutralize acidity, and through the selection and use of specialized materials for the refinery, particularly special alloy steels.

- Extensive refining capacity designed to handle high-TAN crude has been operating in NW Europe and the US Gulf and Atlantic Coast regions for some time. Yet in high-TAN exporting countries of Latin America and Africa, refining capacity for acidic crude is either antiquated and needs renovation (Venezuela), inadequate to the rising tide of domestic high-TAN production (Brazil), or general refining capacity is inadequate to domestic needs, whether running high-TAN grades or not (most of West Africa). Sudan has made a valiant effort to build refining capacity capable of handling its surge of incremental high-TAN output, but new special-build refining capacity is running behind growing acidic crude output.
- With the exception of Brazil, most new capacity to handle acidic crude will be built in Asia Pacific by 2010, with China adding two new special-built refineries for high-TAN slates; India's new Reliance refinery will be able to handle large volumes of high-TAN crude, while Petronas and ConocoPhillips are considering a substantial revamp of its Melaka plant. Other refiners have considered plans to revamp part of their refineries to handle acidic crudes, notably in China, South Korea and Thailand.
- China will continue to dominate high-TAN production, consumption and imports for Asia Pacific at least through the medium term. We expect, however, a significant increase in high-TAN use by South Korea, Taiwan, Malaysia, Singapore and India. Chinese exports to the US West Coast may too rise, depending on system needs of Chevron and ConocoPhillips.
- Three exporting countries will make a substantial impact in the medium term - Brazil, Sudan and Australia. Brazil will export increasing volumes of Marlim, Albacora Leste, Roncador and possibly Polvo to Asia Pacific through 2010, using its new Okinawa refinery as a crude break bulk and re-export facility for East Asian sales. Sudan's growing diplomatic isolation will make it ever more dependent on close economic ties with China and it is likely that most of Fula output, as well as a substantial portion of Dar production, will move to the Chinese market, though Indian and Malaysian buyers may also take a great share of export sales. Australia has two substantial high-TAN crude grades starting up by 2010 and since both are located in Western Australia, most output will be exported to Asian buyers. Smaller, but regular volumes of West African crudes will appear in Asian markets over the medium term and if PSVSA meets its stated goals, large volumes of high-TAN sales will be made to China as well as smaller-volume exports to other Asian markets.